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The present invention relates to a device of pumping for alternate presses of injection to two pistons, intended to distribute fluid with a pressure, or a flow, continuous or quasi-continuous.

Usually pumps, or presses, of injection alternatives to piston consist of a cylinder inside whose a piston moves which, following its direction of displacement, aspires then drives back successively a liquid product to distribute. For this purpose the portion front of the piston delimits a closed room which is provided of two concealable ports, with the mean for example of valves, one of these ports being joined together to a tank containing the liquid one to distribute, and the other port being joined together with the piping in which one wishes to distribute the aforementioned liquid.

The flow of liquid supplied by such alternate presses of injection is not regular, since there is a dead time with fine of each race of suction and repression. In order to improve the regularity of the flow and the pressure of liquid supplied by the presses of injection of this type, one proposed to produce presses made up of two pumps with which the pistons are associated two to two, so that one of the pistons is in phase of suction when the other piston is in phase of repression and vice versa.

If such an arrangement improves the regularity of the flow of the liquid one, it does not prevent however an interruption of celuici when the pistons arrive into fine of race, so that the use of this type of press of injection is excluded for all the applying imposing a flow and a pressure particularly regular, such as for example the groutings of cement in grounds.

The irregularity of the flow and the pressure supplied by such presses comes also from the system from entrainment of those. Indeed, in the case of an order by a system of rod crank, one understands that the displacement of the piston is not constant since it follows a law of movement of the sinusoidal type.

In order to avoid the interruption of flow of these presses of injection, one proposed to shift in time the moment when each piston of the two pumps arrives at the dead point of fine of race, so that at any moment the flow of liquid supplied by the press does not become null. However, in the practice, one noted that it was almost impossible to maintain the pumps in a state of

sufficient synchronism so that the press provides a flow and a pressure of fluid regular.

In addition of such presses do not allow to provide a continuous and progressive variation flow of liquid, since this altering of flow is usually obtained by the means of mechanical interventions such as, for example, the replacement of a pump of a certain section by another pump of different section.

The purpose of the present invention is proposing a device of pumping of the mentioned type which cures the disadvantages previously mentioned while making it possible to ensure a regular flow and a pressure of fluid to distribute.

The present invention thus has as an object a device of pumping for press of injection comprising two piston injection pumps respectively ordered by two jacks operated by fluid hydraulic under pressure, in which each piston of each injection pump is integral of a piston of an associated jack, this piston separating the body from this jack in two rooms, namely a first room, or room of suction, in which one admits the fluid hydraulic one to move the piston in the direction of the suction of the associated pump, and a second room, or room of repression, in which one admits the fluid hydraulic one to move the piston in feel delivery of the associated pump, characterized in that:

- it includes/understands first and second supply means into fluid hydraulic under pressure,
- each jack is supplied by the first supply means to move its piston in the direction of the delivery of the associated pump, and by the second supply means to move its piston in the direction of the suction of the associated pump,
- it includes/understands at least means sensors adapted to detect fine race of repression of each piston of the jacks,
- it includes/understands means of order controlling the aforementioned first and second supply means into fluid hydraulic under pressure of the jacks so that
- once its race of finished suction, each piston of jack moves in reverse direction to actuate the associated pump in order to carry out a precompression of the product aspired by this pump, jusqu has a value of neighbouring pressure of the pressure to which will be carried out of the aforesaid repression produces, and to maintain this pressure until the reception of an order of bringing in phase of repression of the aforesaid the pump,
- into fine of race of repression, the passage of the piston of jack ordering this one, in the vicinity of the sensor of fine of race of repression starts the step of repression of the other hydraulic piston.

The present invention also has as an object an hydraulic distributor for device of pumping comprising at least two ways of extended and a drawer supplied with fluid hydraulic, mounted slidable compared to the two ways of extended in order to progressively putting each one of those in communication with the fluid hydraulic one delivered by the drawer, characterized in that the lateral blanks of the drawer are inclined towards the inner one compared to the surface of sliding motion.

One will describe hereafter, as nonrestrictive example, a form of execution of the present invention, in reference to the annexed drawing on which

- figure 1 is a schematic sight of a device of pumping for alternate press with two pistons following the invention.
- figure 2 is graphic representing the position of each piston of the pump according to time.
- the figures 3a and 3b are schematic sights partial of a distributor of fluid implemented in the devices of the former state of the technical one.
- the figures 3c and 3D are schematic sights partial of a distributor of fluid implemented in the following device the invention.
- the figure 3rd is a sight of detail on larger scale of an alternative of bringing in work of the distributor represented on the figures 3c and 3D.

The press of injection following the invention, represented on figure 1, is composed of two pumps it and lb ordered by two respective hydraulic jacks 3a, 3b. Each pump, lb makes up of a body 5a, 5b inside whose is mounted slidable, in a sealed way, a piston 7a, 7b whose movement is ordered by a stem of piston 9a, 9b which is actuated by the jack 3a, 3b. For this purpose, the jack 3a, 3b comprise a jack there, llb inside whose is mounted slidable, in a sealed way, a piston 13a, 13b comprising a stem of piston 15a, 15b, of which the outer end is integral of the corresponding outer end of the stem of piston 9a, 9b of the pump, lb. Each pump, lb comprises a working chamber 17a, 17b which is in communication, by a piping 19a, 19b, with a tank 21 container the liquid 23 that one wishes to distribute, and who is in the present case a cement grout, with interposition of a non-return valve 25a, 25b, authorizing the passage of liquid 23 only tank 21 towards the working chamber 17a, 17b.

This 17b, working chamber 17a, is also in communication, by a piping 18a, 18b, with a piping of use 29, i.e. a piping in which one wishes to send the liquid one to distribute, with interposition of a non-return valve 27a, 27b, this valve authorizing the passage from the liquid 23 only of the working chamber 17a, 17b towards piping 29.

The body there, llb of each jack of order 3a, 3b is separate in two sealed rooms by the piston 13a, 13b, namely a room of repression 31a, 31b, located on a portion, said portion "front", jack 3a, 3b and a room of suction 33a, 33b located on the other portion, said "rear" portion, of the jack 3a, 3b. Each room of suction 33a, 33b is in communication, by a piping 45a, 45b with a electrodistributor 47. Each room of repression 31a, 31b is joined together, by a piping 34a, 34b with extended the 38a, 38b of an hydraulic distributor 37a, 37b with three positions whose operation will be described hereafter.

The following device the invention includes/understands a first pumps 39, which is in

communication with a reserve from fluid hydraulic 41, via a filter 43. Pump 39 is an hydraulic pump with flow and pressure of fluid variable and adjustable, which makes it possible to regulate the rate of travel of the pistons 13a and 13b like hereafter exposed, in order to controlling the speed of injection of the product to distribute 23. Fluid hydraulic, the of extended one of pump 39 is directed towards a electrodistributor 40 in open center which, itself, feeds the two hydraulic distributors respectively 37a, 37b. The hydraulic distributors 37a, 37b are provided of two elements of order 35a, 36a and 35b, 36b respectively which makes it possible to make them occupy three different configurations, namely of first hand, a configuration A, when the elements of order 35a, 35b are activated, in which the pipings 34a, 34b are respectively in communication with the pipings 45a, 45b, of second hand a configuration C, when the elements of order 36a, 36b are activated, in which the pipings 34a, 34b are respectively in communication with pipings 42a, 42b connected to two extended respective of the électrodistribution 40 and, of third hand, one configuration B, when the elements of order are not activated, in which the pipings 34a, 34b are joined together with nothing.

Electrodistributor 40 is a electrodistributor with two positions and is said "in open center", i.e. it has no position in which the passage of fluid hydraulic is completely blocked. One respectively represented, in schematic form, on the figures 3a and 3b on the one hand and 3c and 3D on the other hand, a electrodistributor in following open center the state former of technical and a electrodistributor to following progressive open center 1 invention, in position of intake on a single way and the two ways.

Each électrodistribeurs represented on these figures comprises a way 22 and one way 24 intended to be successively fed into fluid hydraulic under control of a movable drawer 26 which receives from a pump, such as pump 39, an hydraulic flow of adjustable flow.

On the figures 3a and 3b the lateral sides 46 of drawer 26 are substantially perpendicular on the surface of sliding motion of this one, so that a low displacement D of drawer 26 in direction of the other way 22 causes to cause an abrupt variation of flow and pressure loss in the aforementioned way 22. On the other hand, in the distributor in following progressive open center the invention, represented on the figures 3c and 3D, the lateral sides 48 of drawer 26 are inclined towards the inner one compared to the surface of sliding motion and form an angle has with this one, so that a same displacement D of the drawer causes, in beginning and fine of race, a pressure loss and thus a very progressive variation of flow according to the angle have lateral sides 48.

In the examples described here, this angle A is about 30 but of other values can also be selected according to the applying considered. One can also, as represented on the figure 3rd, to make call with other profiles 48 ' that linear, allowing to refine the progressive character of the flow and the pressure loss created.

The tests carried out by the applicant have established that the distributors of this type make it

possible to obtain an order particularly progressive and without jolt of the jacks, and thus of the flow of product delivered 23.

Electrodistributor 40 is provided of two windings of order, respectively 40a and 40b which makes it possible to put it in three different configurations knowing: of first hand, when the winding 40a is fed, a configuration A, in which one authorizes the circulation of fluid hydraulic coming of pump 39 in a piping 42a feeding the hydraulic order 36a distributor 3a and in the piping 42a, of second hand, when the winding 40b is fed, a configuration C in which, one authorizes the circulation of fluid hydraulic coming of pump 39 in the piping 42b feeding the hydraulic order 36b distributor 37b and in the piping 42b and, of third hand, when the electro distributor is at rest, a configuration B, which is a transeunt configuration and in which, one ensures communication of the pipings 42a and 42b with pump 39.

Each room of suction 33a, 33b of the hydraulic jacks 3a, 3b is connected, by the piping 45a, 45b, with the electro distributor common to open center 47. The device includes/understands a second hydraulic pump in addition, or pumps suction 55, with fixed, sucking flow fluid the hydraulic contents in the reserve from fluid hydraulic 41, via a filter 57, to send it, under a P2 pressure, with an inlet 46a of electro distributor 47, by a piping 53a. Electro distributor 47 is provided of two windings of order, respectively 49a and 49b, which makes it possible to put it in three different configurations knowing: of first hand, when the winding 49a is fed, a configuration A in which one authorizes the circulation of fluid hydraulic in the respective pipings 45a, 45b, in the direction of the arrows B, of second hand, when the winding 49b is fed, a configuration C in which electro distributor 47 authorizes the circulation of fluid hydraulic in the respective pipings 45a, 45b, in the direction of the arrows has, and of third hand, when electro distributor 47 is at rest, i.e. when its windings 49a and 49b are not fed, a configuration B in which one ensures the communication entreelles of the pipings 45a, 45b, and reserve from fluid hydraulic 41.

Each jack 3a, 3b comprises two detectors, namely a detector of fine of race of suction Ea, Eb, and a detector of fine of race of repression Ga, GB. These detectors which can be, for example, made up of electronic proximity detectors, make portion of an electric control device of this device.

One represented on figure 2 race 1 of each piston 13a, 13b of the hydraulic jacks, 1b according to time, in the case of an operation under large flow.

One will expose the operation of the following device hereafter the invention compared to the joined figures. One will take for starting position, a position in which the piston 13a of the jack 3a is into fine of race of repression (not O of figure 2), the piston 13b of the jack 3b having then begun its cycle of repression (Not NR of figure 2).

Under these conditions, rolling up 49a of electro distributor 47 is energized so that it is in configuration A and than the fluid hydraulic one can, starting from pump 55, to run out towards

the room of suction 33a of the hydraulic jack 3a, in the direction of the arrow B, into through, by the piping 53a, electro distributor 47 and the piping 45a. Under the action of the fluid hydraulic one, the order 35a of the distributor 3a is activated, so that this one is put in configuration A what allows the circulation of fluid hydraulic between its extended 38a and the piping 45a. The fluid hydraulic one is thus admitted at the same time in the room of suction 33a and the room of repression 31a, so that, because of the more substantial surface of the piston 13a in the room of suction 33a, this one is pushed back in the direction of the suction (on the straight one on figure 1), and fluid the hydraulic contents in the room of repression 31a are driven back in the circuit into through the distributor 37a towards the piping 45a. The piston 7a of the pump it is thus actuated in the direction of the suction (on the straight one, on figure 1), and the liquid product 23 to distribute, is contained in tank 21, is admitted by the piping 19a, through the valve 25a, in the room of suction 17a of the pump. This phase corresponds to line OAS, of figure 2.

At the moment O, as shown on figure 2, the piston 13b of the hydraulic jack 3b began as for him its phase of repression, and it will continue this one until time  $t_{Qb}$ , which represents the  $Nt_{Qb}$  portion of the curve of figure 2.

For this making, the winding 40b of electro distributor 40 is energized, so that it is put in the configuration C what makes it possible fluid hydraulic coming of pump 39 to be sent under a P1 pressure, towards the hydraulic order 36b of the distributor 37b, which puts this last in configuration A and thus allows fluid hydraulic to be allowed in the room of compression 31b of the hydraulic jack 3b, and to push back its piston 13b, and thus the piston 5b of the pump 1b, so that this one drives back the product 23 thus to distribute through the valve 27b, towards piping 29.

The electronic means of order, which could be as well systems in all or only of the systems with progressive order, and especially of the microprocessors and/or microcontrollers, are such as as soon as the sensor of fine of race of Ea suction of the jack 3a detects fine race they let run out a  $Dt$  time, about some tenth of second, allowing the stabilization of the system, then, after this phase of stabilization, they order the request of the piston 13a, in the direction of repression, by the injection of fluid hydraulic resulting from a third pump, said pump of precompression 56, through a electro distributor 58. Fluid the hydraulic sent one by the pump of precompression 56 requests the piston 13a jack 3a in order to exert on the piston 7a pump 5a an effort carrying out a precompression of the aspired product, in order to bring it to a pressure level identical so that it will be during the phase of repression. The pump of precompression 56 is adapted to maintain a level of P3 precompression and a flow of fluid hydraulic until the piston 13a of the hydraulic jack 3a receives the order to begin its phase of repression.

This provision improves the regularity of operation of the press by avoiding the fall of pressure which usually after occurs the phase of suction.

Thanks to the device implemented in the present invention, as soon as the hydraulic jack has

received the order to carry out repression it is in measurement, immediately, to carry out celuici, without there being a dead time between the moment of reception of the order and the moment when the discharge pressure reaches the desired value. The defects of regularity which appear usually at the beginning of phase of repression are thus avoided. The device can include/understand adjustable means of temporization making it possible to control and limit in time the duration of this precompression according to the mechanical characteristics of the installation and the supplied flows.

As represented on figure 2, the beginning of the phase of repression of the piston 13a is started, at one moment  $t_{Gb}$ , corresponding at the moment when the piston 13b of the other hydraulic jack 3b passes in front of its detector of fine of race of repression GB.

In this way, when the piston 13b arrives into fine of race of repression, at the moment  $t_{Qb}$ , the piston 13a already started its phase of repression. At the moment  $t_{Qb}$  the system of ordering of the device feeds the winding 49b of electro distributor 47, so that this one is in configuration C and than pump 55 sends the fluid hydraulic one in the piping 45b, in the direction of the arrow B, to arrive in the room of suction 33b of the jack 3b and to push back its piston 13b in the direction of the suction. The cycle continues thus, in a symmetrical way, like previously exposed.

## CLAIMS

1. Device of pumping for press of injection comprising two pumps injection with piston (, 1b) respectively ordered by two jacks (3a, 3b) operated by fluid hydraulic under pressure, in which each piston (7a, 7b) of each injection pump (, 1b) is integral of a piston (13a, 13b) of an associated jack (3a, 3b), this piston separating the body (there, 11b) from this jack in two rooms, namely a first room, or room of suction (33a, 33b), in which one admits the fluid hydraulic one to move the piston (13a, 13b) in the direction of the suction of the associated pump (, 1b), and a second room, or room of repression (31a, 31b), in which one admits the fluid hydraulic one to move the piston (13a, 13b) in the direction of the repression of the associated pump (, 1b), characterized in that:

- it includes/understands first (39) and second means (55) of food into fluid hydraulic under pressure,
- each jack (3a, 3b) is supplied by the first supply means (39) to move its piston (13a, 13b) in the direction of the repression of the pump (, 1b) associated, and by the second supply means (55) to move its piston (13a, 13b) in the direction of the suction of the pump (, 1b) associated,
- it includes/understands at least means sensors (Ga, GB) adapted to detect fine race of repression of each piston (13a, 13b) of the jacks (3a, 3b),
- it includes/understands means of order controlling the aforementioned first (39) and second means (55) of food into fluid hydraulic under pressure of the jacks (3a, 3b) so that
  - once its race of finished suction, each piston (13a, 13b) of jack moves in reverse direction to actuate the associated pump in order to carry out a precompression of the product (23) aspired by this pump, up to a value of neighbouring pressure of the pressure to which will be carried out of the aforesaid repression produces (23), and to maintain this pressure until the reception of an order of bringing in phase of repression of the aforesaid the pump,
  - into fine of race of repression, the passage of the piston of jack ordering this one, in the vicinity of the sensor of fine of race of repression (Ga, GB) starts the step of repression of the other hydraulic piston (13a, 13b).

2. Following device claim 1 characterized in that the phase of precompression is ensured by third supply means into fluid under pressure (56).

3. Following device the claim 1 or 2 characterized in that the means of order are such, which once the means sensors (Ea, Eb) detected fine race of suction of a jack (3a, 3b) it impose on this one one immobilization period of brief duration (Dt), where period of stabilization, preceding the phase by precompression.

4. Following device any of the preceding claims characterized in that the aforementioned immobilization period is adjustable according to the flow of fluid hydraulic necessary to ensure the repression of a piston (13a, 13b) of jack (3a, 3b).

5. Following device any of the preceding claims characterized in that it includes/understands a separate pump (56), intended to ensure the precompression of the product to be distributed (23) allowed in the pump at the time of the phase of suction.
6. Hydraulic distributor for following device any of the preceding claims, comprising at least two ways of extended (22,24) and a drawer (26) supplied with fluid hydraulic, mounted slidable compared to the two ways of extended (22,24) in order to progressively putting each one of those in communication with the fluid hydraulic one delivered by the drawer (26), characterized in that the lateral blanks (48) of the drawer (26) are inclined towards the inner one compared to the surface of sliding motion.
7. Following distributor claim 6 characterized in that the slope of the lateral blanks (48) is about three to six degrees.